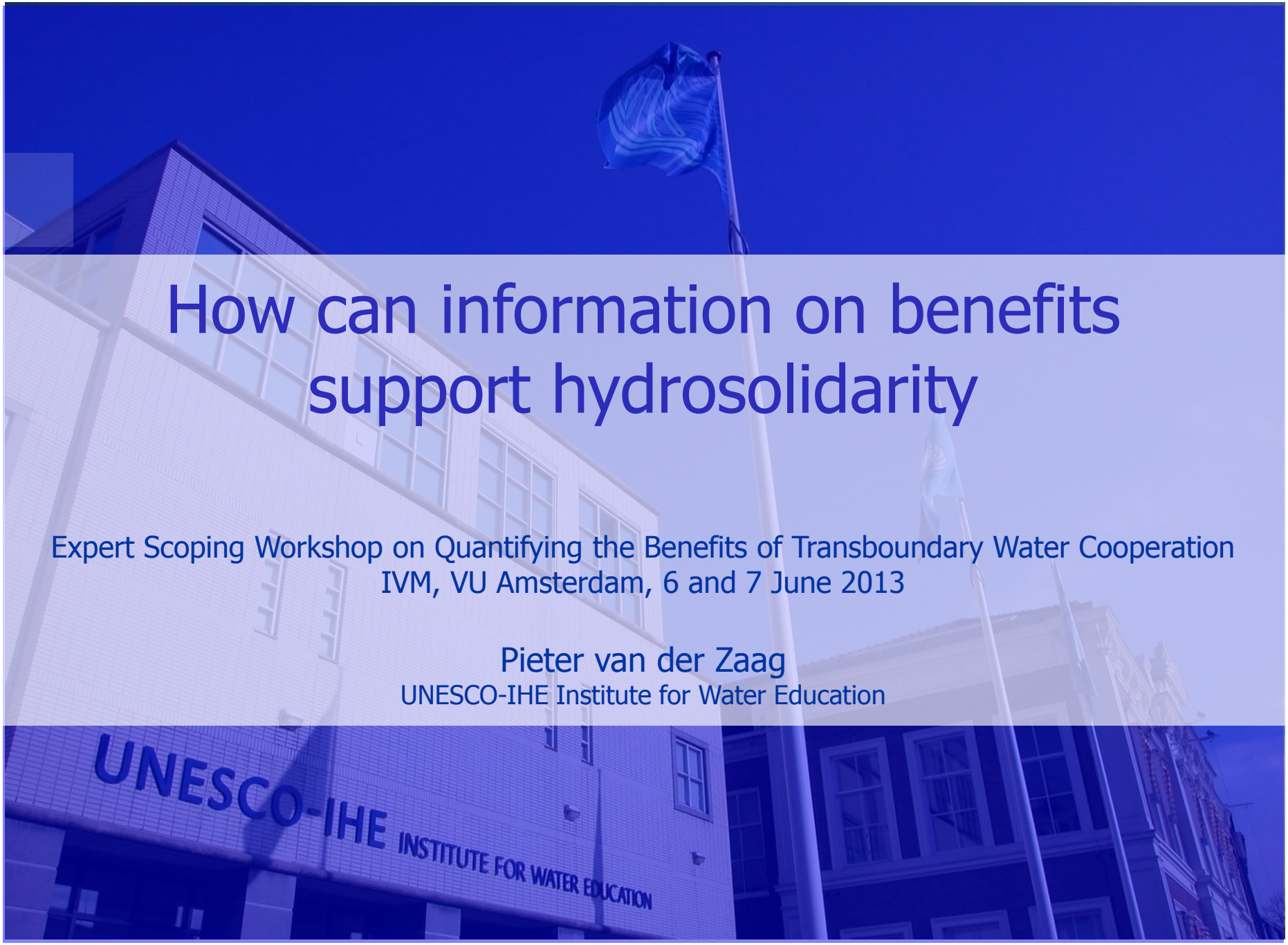



# How can information on benefits support hydrosolidarity

Expert Scoping Workshop on Quantifying the Benefits of Transboundary Water Cooperation
IVM, VU Amsterdam, 6 and 7 June 2013

Pieter van der Zaag
UNESCO-IHE Institute for Water Education

# Information – benefits – hydrosolidarity

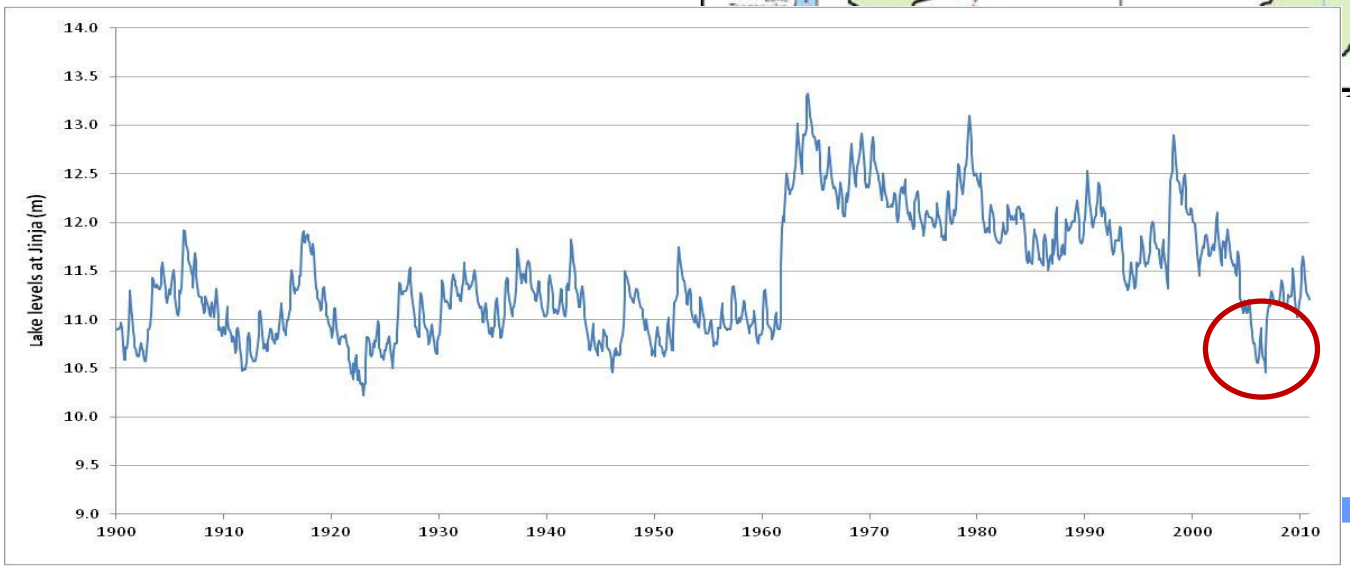
1. Information on benefits or benefits from information?
   - the case of Lake Victoria
2. Data sharing & technical cooperation
   - the case of the Zambezi basin
3. Benefit sharing: joint infrastructure development
   - four African cases
4. Benefit sharing
   - the Blue Nile
5. Define system boundaries
   - watershed, problemshed, precipitationshed, benefitshed

# Information on benefits or benefits from information?

Imprecise information may feed distrust and conflict

# Information

## Lake Victoria basin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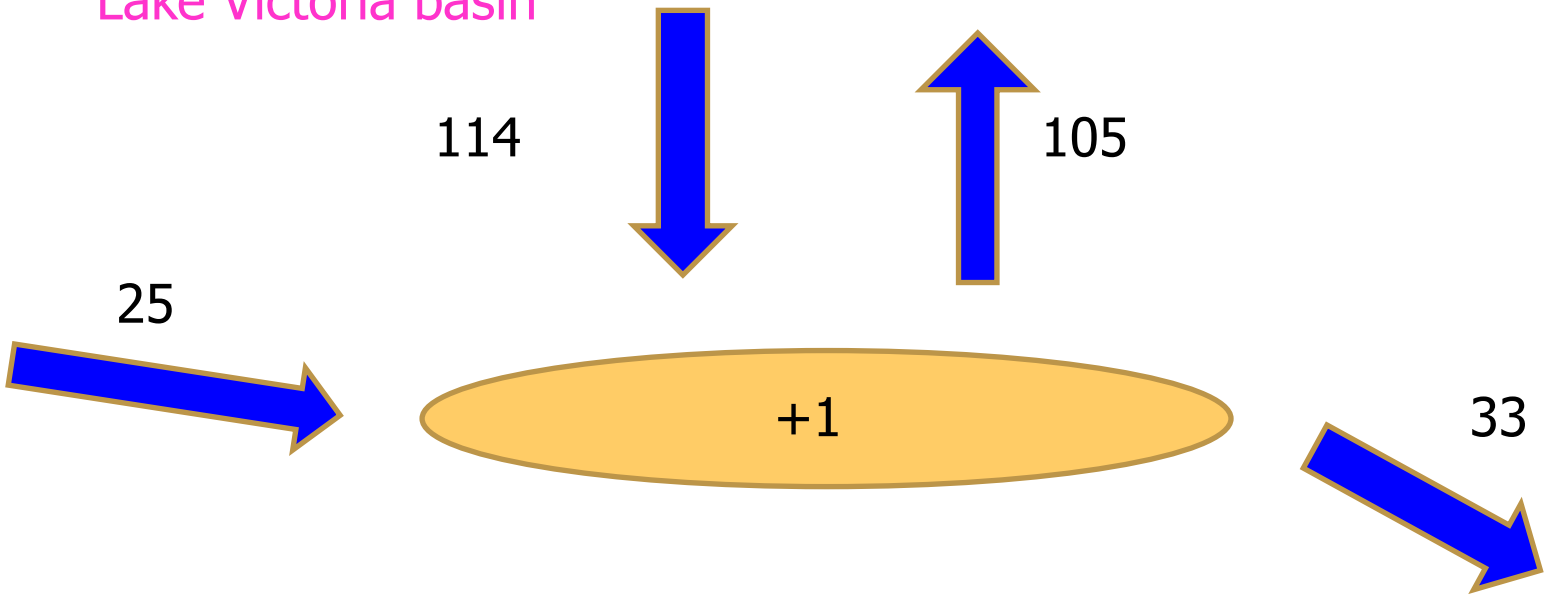
# Information

## Water Balance Lake Victoria, 1950-2000 ($km^3/yr$)

Lake Victoria basin



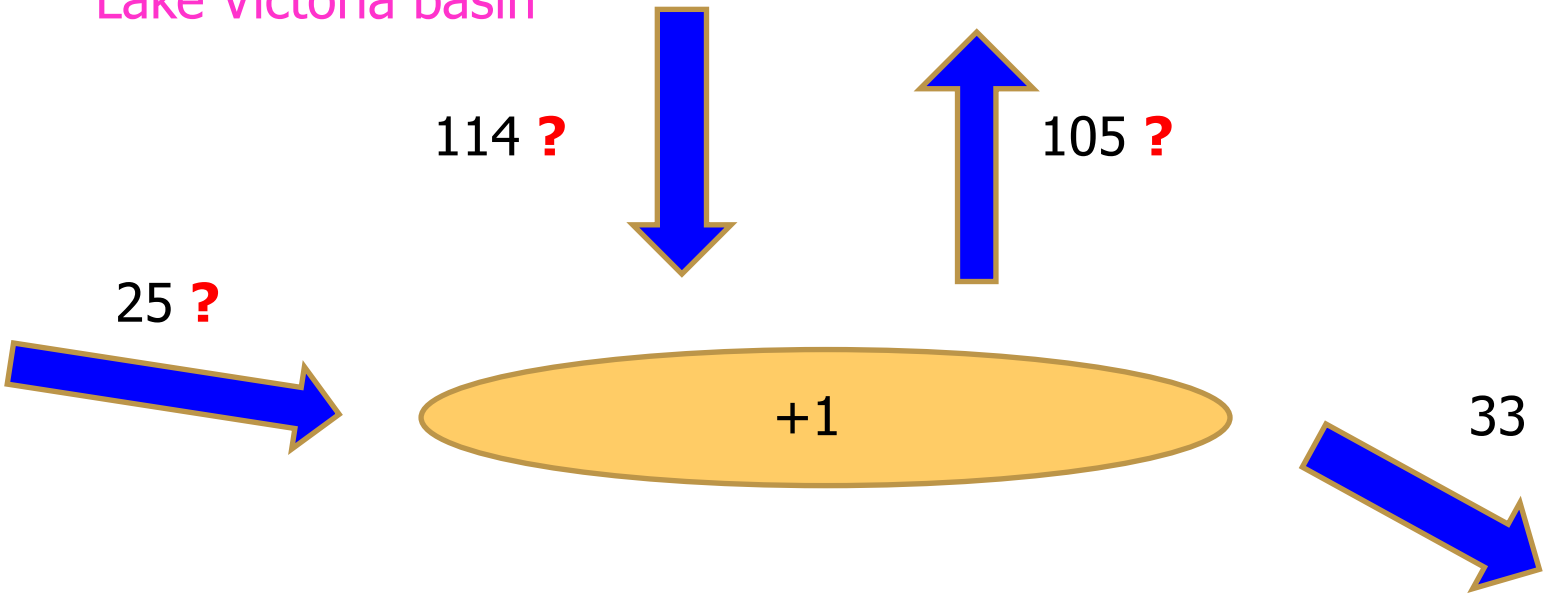

| | |
|---|---|
| Surface area: | 67,000 $km^2$ |
| Volume: | 2,750 $km^3$ |

Source: adapted from LVEMP I Hydrology and Meteorology Report (2005)

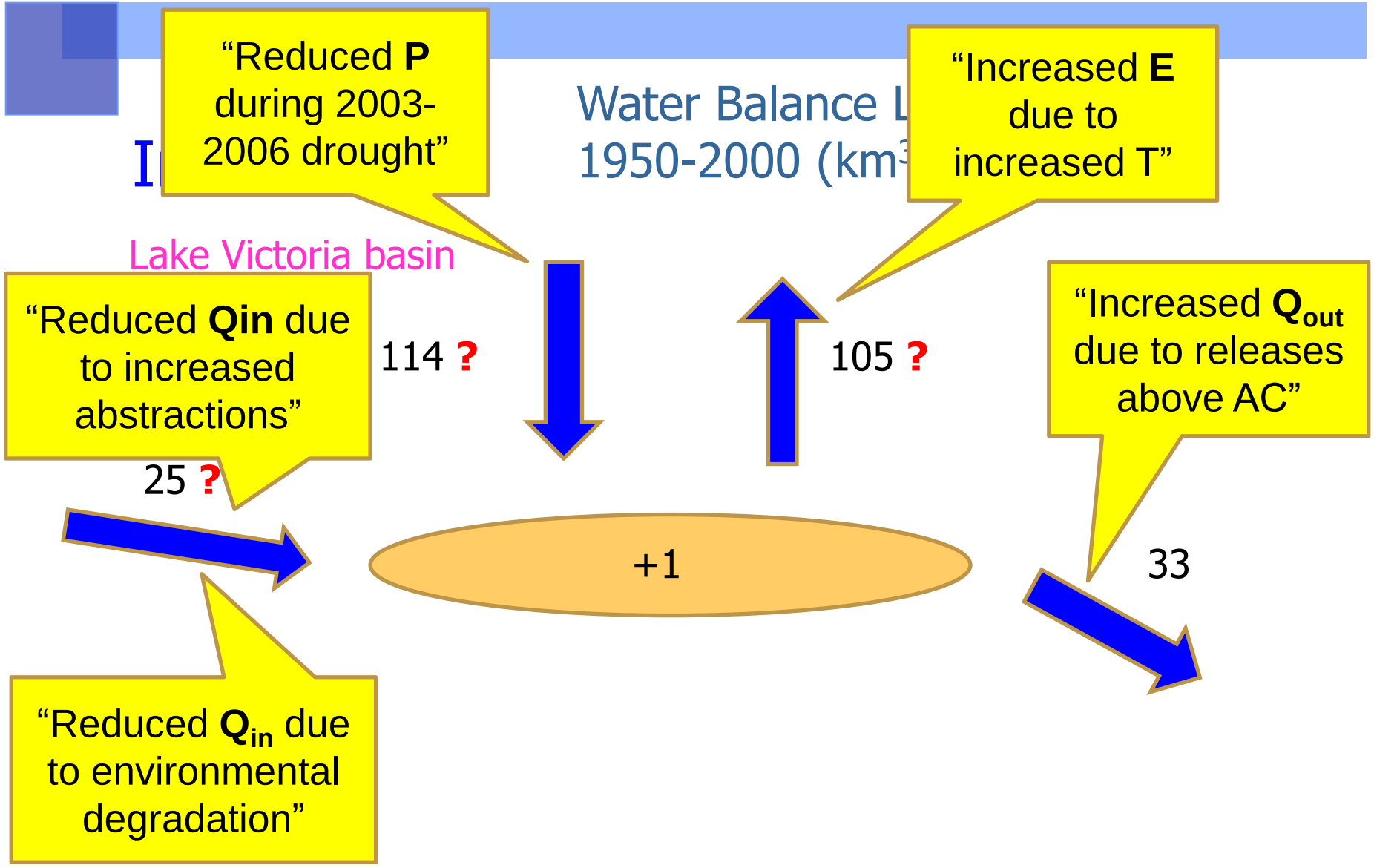
# Information

## Water Balance Lake Victoria, 1950-2000 ($km^3/yr$)

Lake Victoria basin



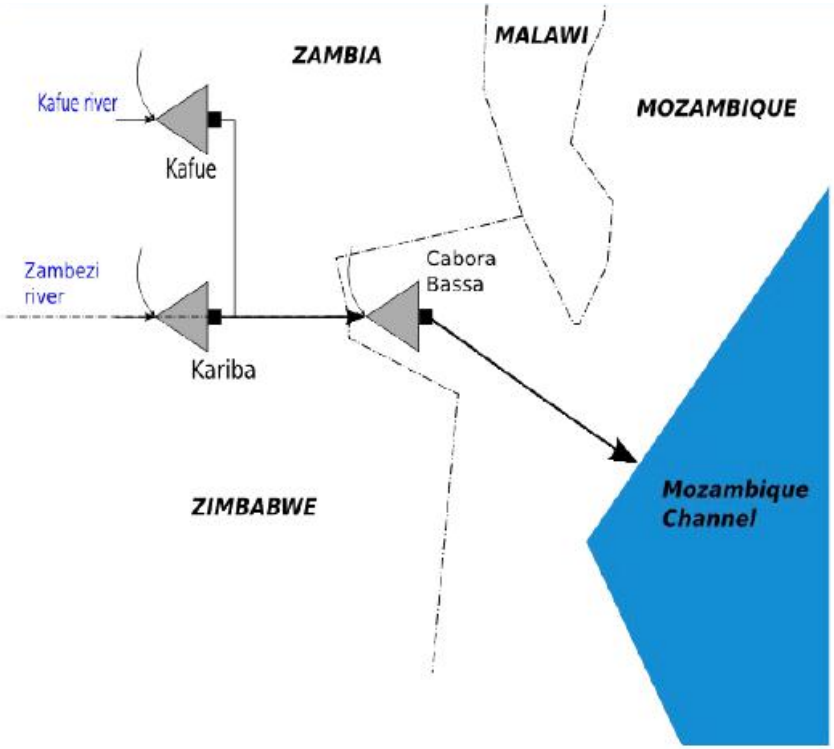

Uncertainties create room for different explanations

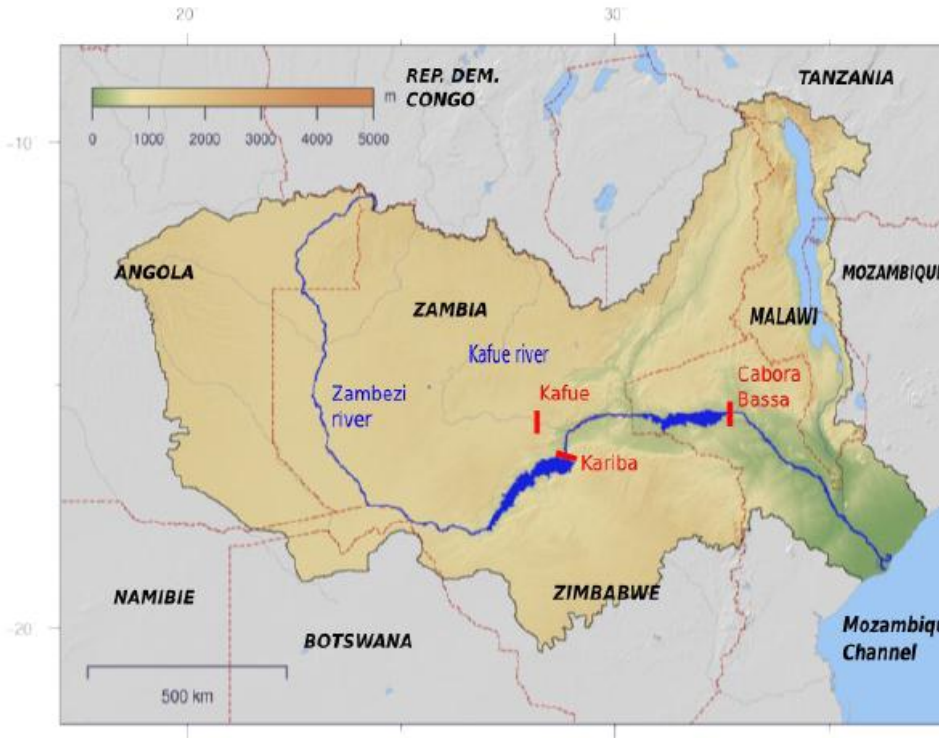

Water Balance L
1950-2000 (km³
Lake Victoria basin
"Reduced P during 2003-2006 drought"
"Increased E due to increased T"
"Reduced Qin due to increased abstractions"
114 ?
105 ?
"Increased Qout due to releases above AC"
25 ?
+1
33
"Reduced Qin due to environmental degradation"

# Data sharing & technical cooperation

# Data sharing & technical cooperation

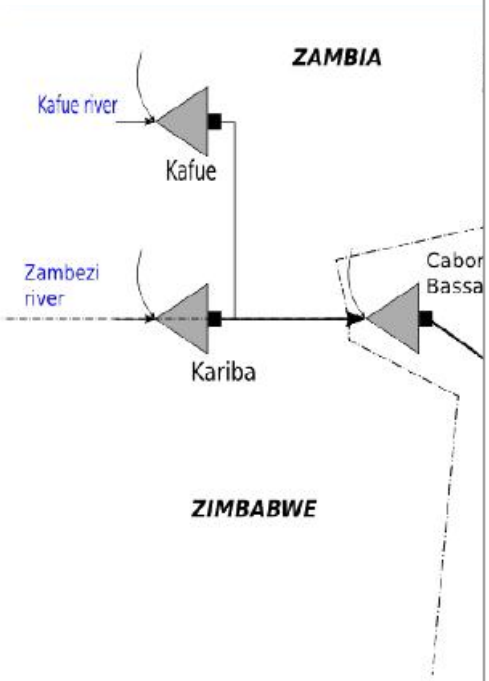
## Zambezi

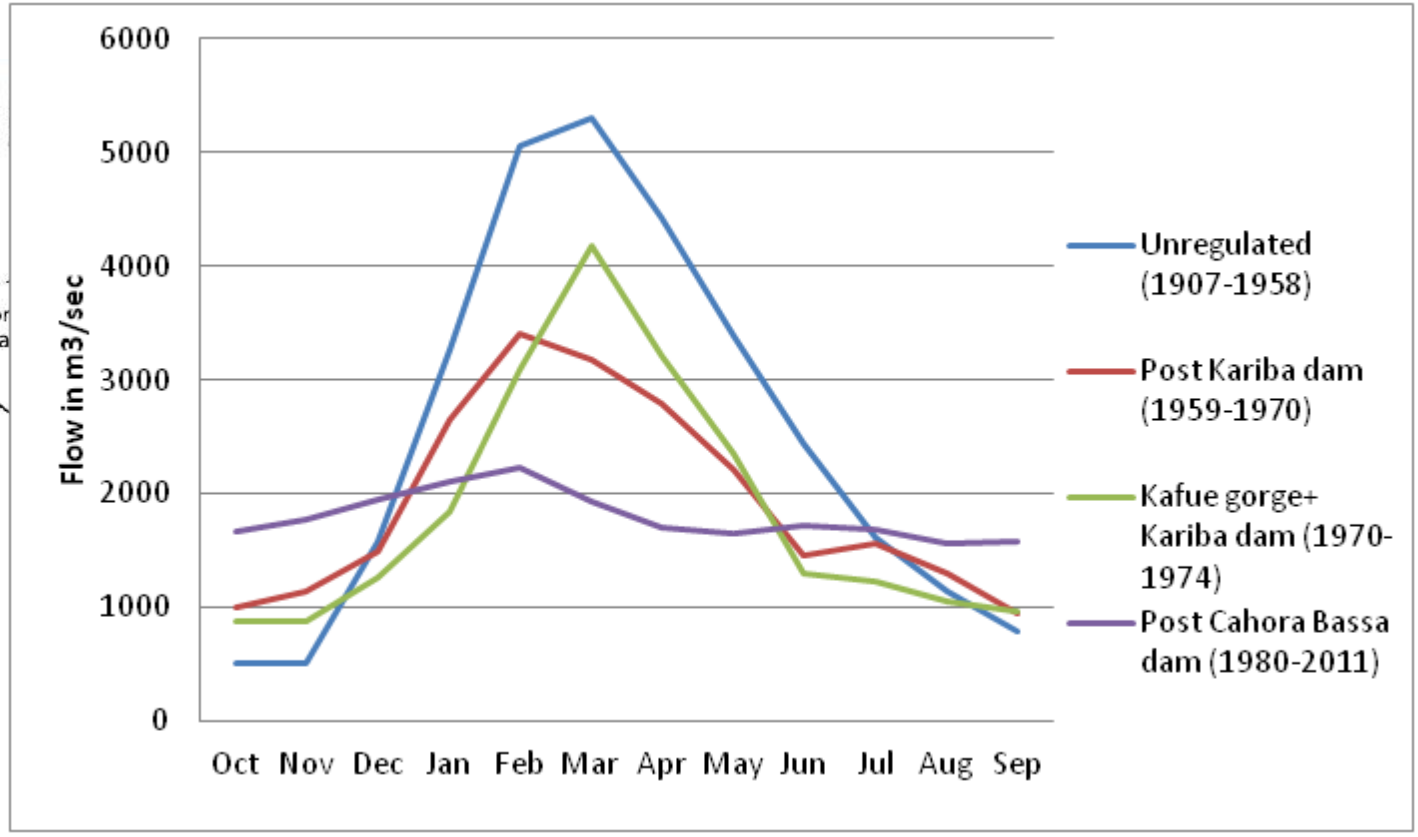


# Data sharing & technical cooperation

## Zambezi



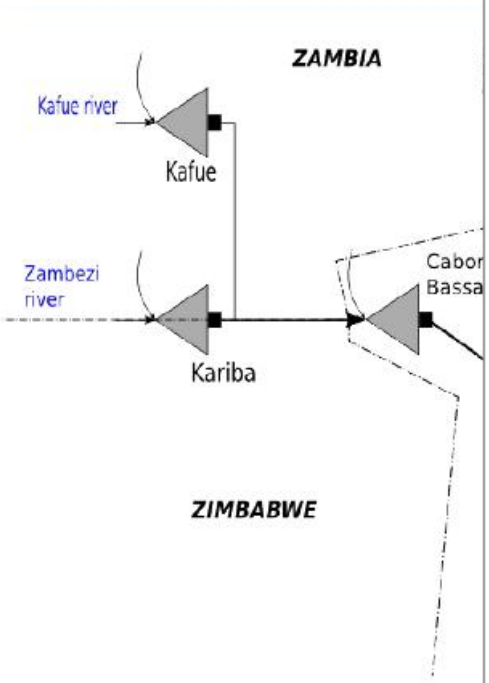

Monthly average discharge at Cahora Bassa gorge (Source: Fanaian, 2013)

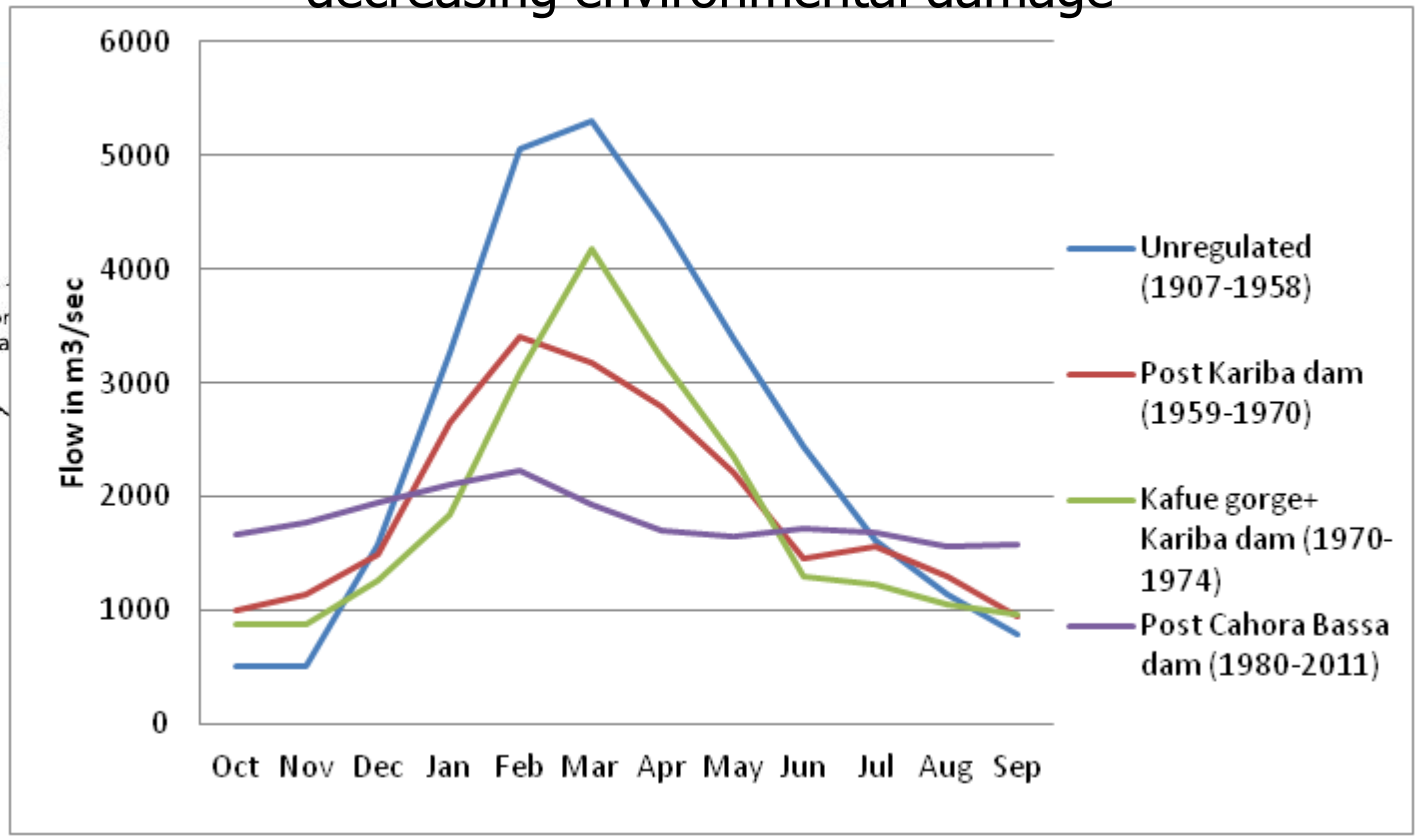
# Data sharing & technical cooperation

Zambezi

Dam synchronisation; JOTC:

- enhancing benefits and safety
- decreasing environmental damage




Monthly average discharge at Cahora Bassa gorge (Source: Fanaian, 2013)

# Data sharing & technical cooperation

Zambezi

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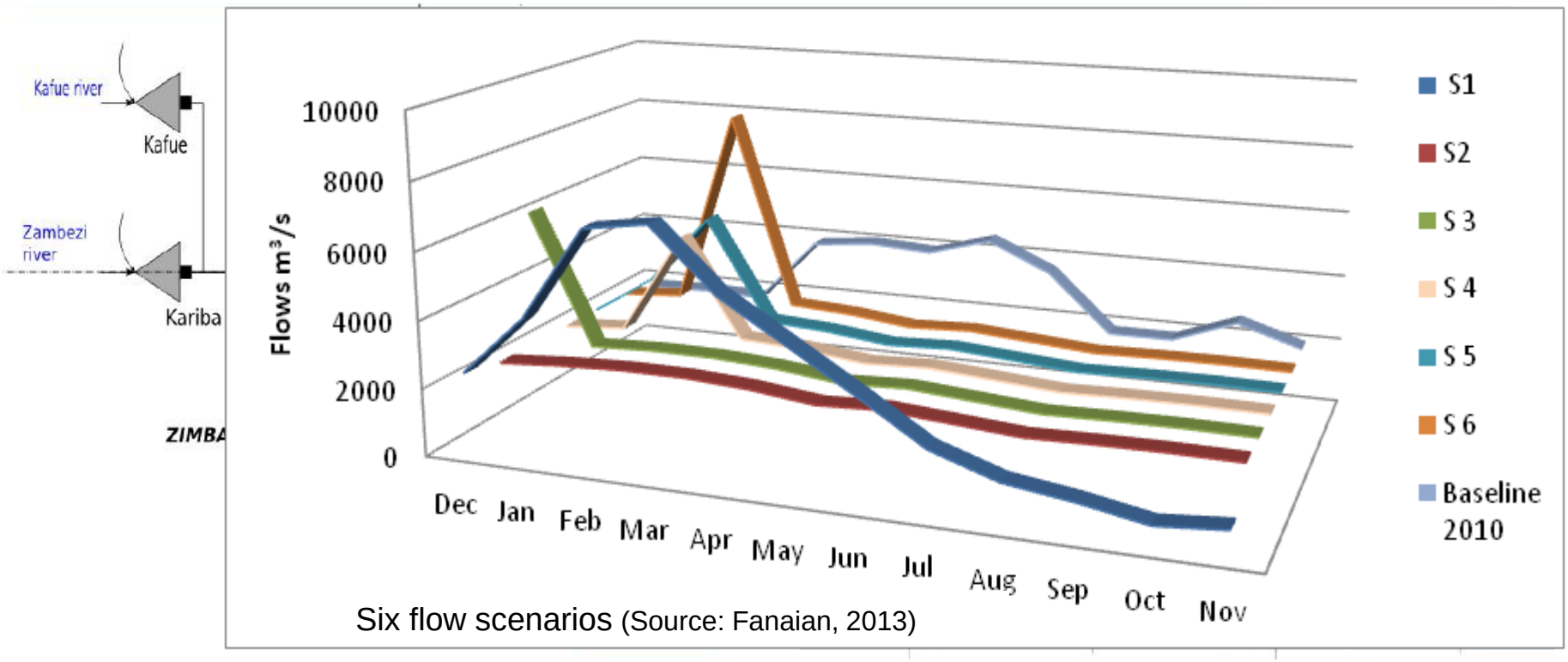


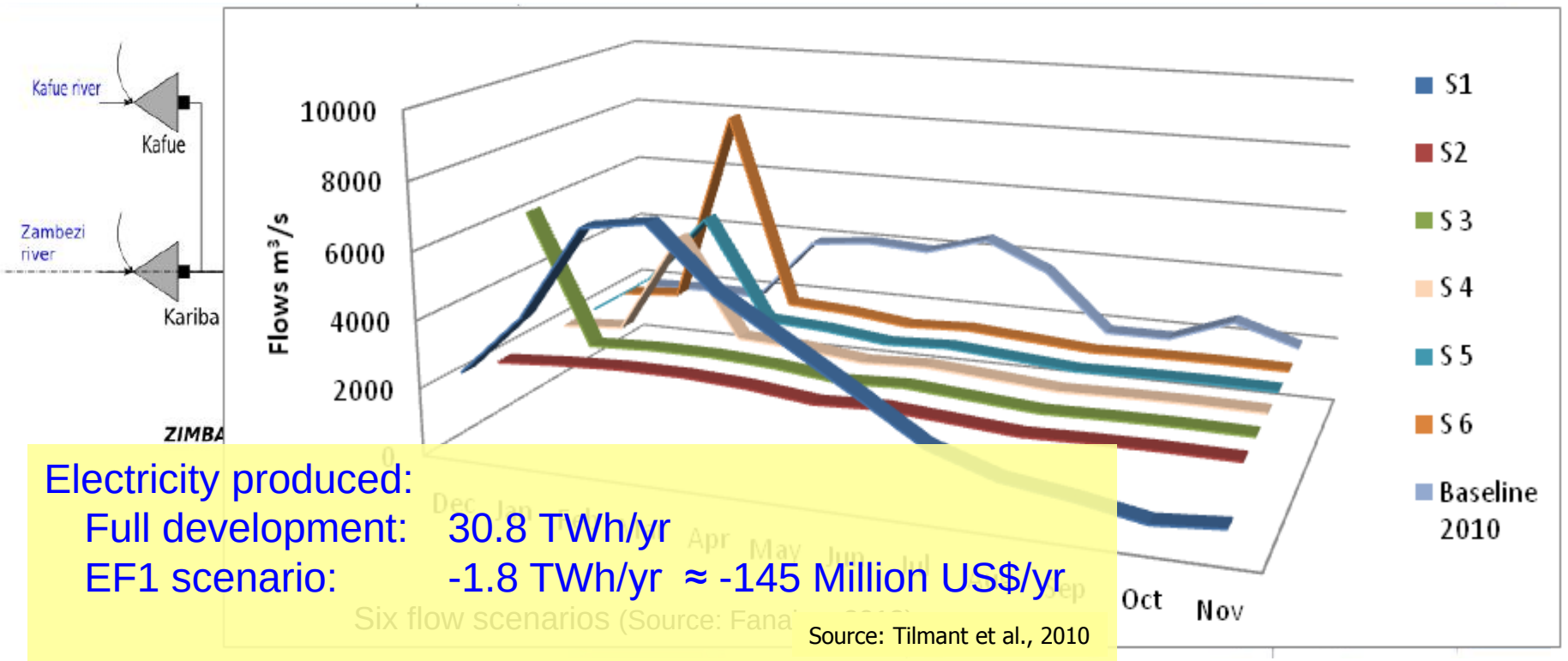

Six flow scenarios (Source: Fanaian, 2013)

# Data sharing & technical cooperation

Zambezi

Dam synchronisation; JOTC:

- enhancing benefits and safety
- decreasing environmental damage




Six flow scenarios (Source: Fana

Electricity produced:

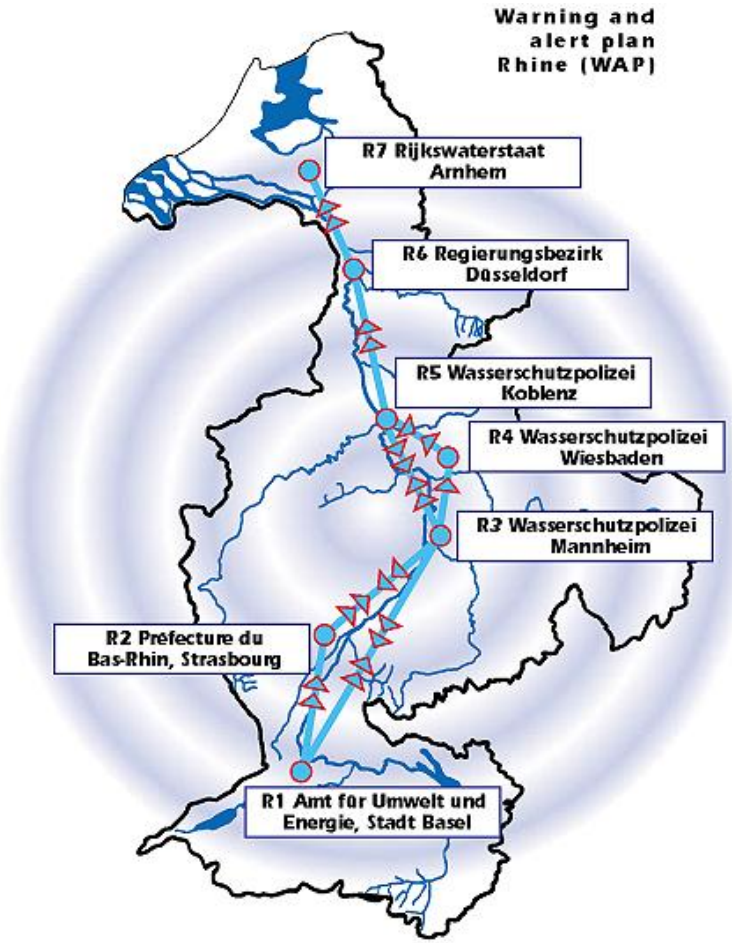
Full development: 30.8 TWh/yr

EF1 scenario: -1.8 TWh/yr ≈ -145 Million US$/yr

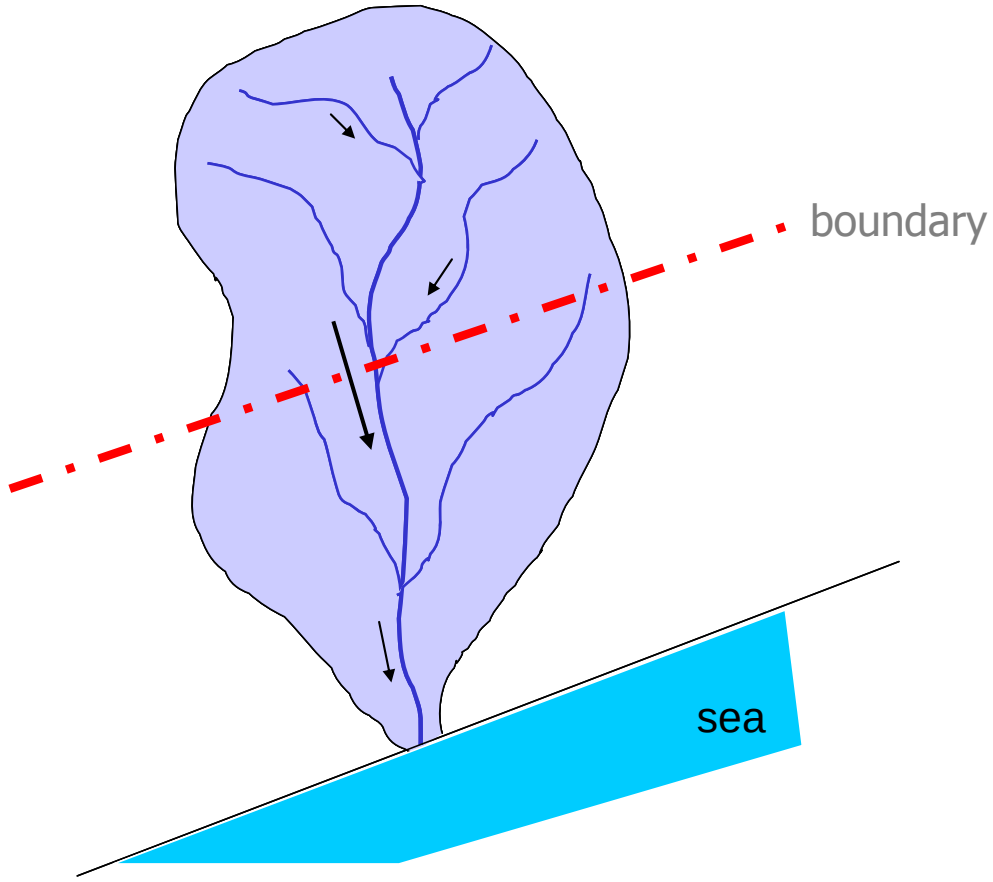
Source: Tilmant et al., 2010

# Data sharing & technical cooperation

Rhine

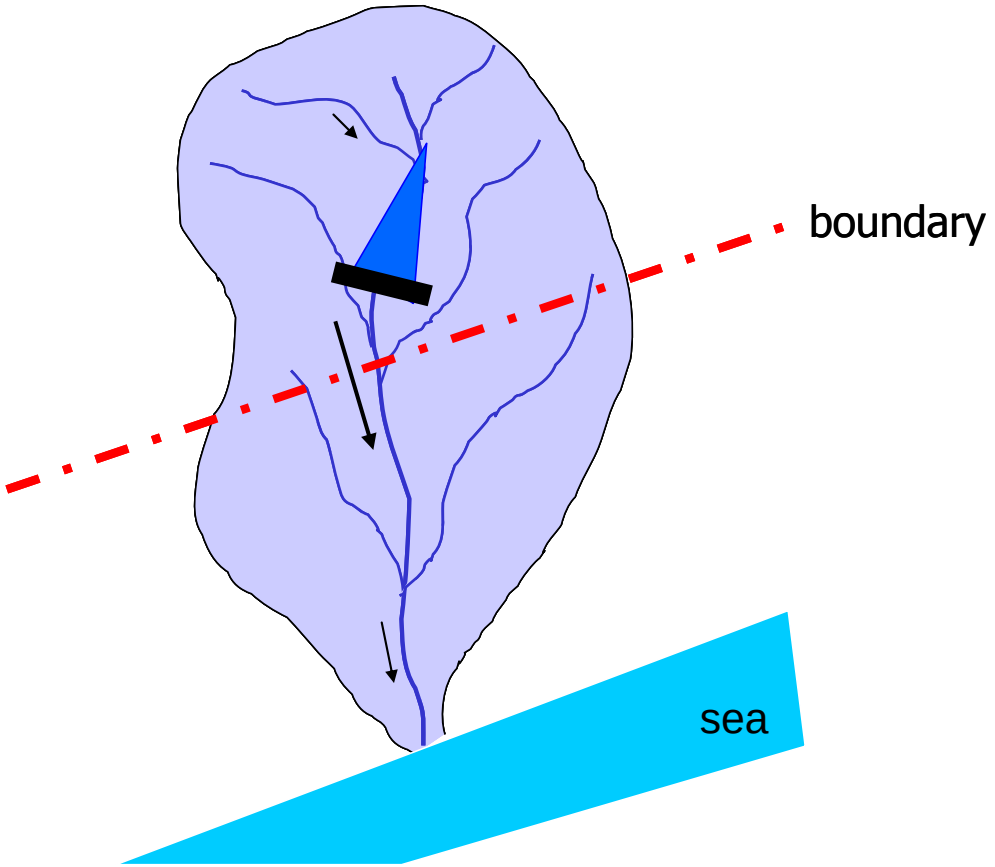


# Benefit sharing



# Benefit sharing

Joint infrastructure development!



# Benefit sharing

Joint infrastructure development!

Khatse dam - Orange river

Kariba dam - Zambezi river

Maguga dam - Incomati river

Manantali dam - Senegal river


International River Basins of AFRICA

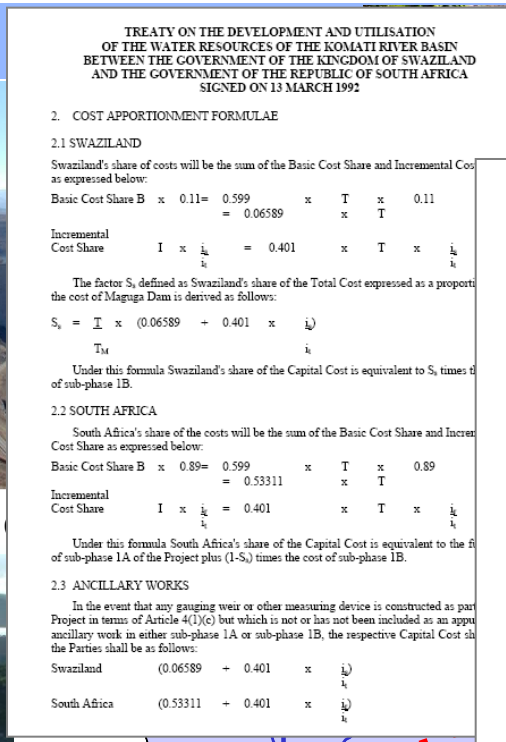
# Benefit sharing

## Joint infrastructure development!

Khatse

Maguga dam - Incomati river

Manantali dam - Senegal river



TREATY ON THE DEVELOPMENT AND UTILISATION
OF THE WATER RESOURCES OF THE KOMATI RIVER BASIN
BETWEEN THE GOVERNMENT OF THE KINGDOM OF SWAZILAND
AND THE GOVERNMENT OF THE REPUBLIC OF SOUTH AFRICA
SIGNED ON 13 MARCH 1992

2. COST APPORTIONMENT FORMULAE

2.1 SWAZILAND

Swaziland's share of costs will be the sum of the Basic Cost Share and Incremental Cos
as expressed below:

Basic Cost Share B x 0.11= 0.599 x T x 0.11
= 0.06589 x T

Incremental
Cost Share I x $\frac{i_k}{i_t}$ = 0.401 x T x $\frac{i_k}{i_t}$

The factor $S_s$ defined as Swaziland's share of the Total Cost expressed as a proporti
the cost of Maguga Dam is derived as follows:

$S_s = \frac{T}{T_M} \times (0.06589 + 0.401 \times \frac{i_k}{i_t})$

Under this formula Swaziland's share of the Capital Cost is equivalent to $S_s$ times t
of sub-phase 1B.

2.2 SOUTH AFRICA

South Africa's share of the costs will be the sum of the Basic Cost Share and Increm
Cost Share as expressed below:

Basic Cost Share B x 0.89= 0.599 x T x 0.89
= 0.53311 x T

Incremental
Cost Share I x $\frac{i_k}{i_t}$ = 0.401 x T x $\frac{i_k}{i_t}$

Under this formula South Africa's share of the Capital Cost is equivalent to the f
of sub-phase 1A of the Project plus (1-$S_s$) times the cost of sub-phase 1B.

2.3 ANCILLARY WORKS

In the event that any gauging weir or other measuring device is constructed as par
Project in terms of Article 4(1)(c) but which is not or has not been included as an appu
ancillary work in either sub-phase 1A or sub-phase 1B, the respective Capital Cost sh
the Parties shall be as follows:

Swaziland (0.06589 + 0.401 x $\frac{i_k}{i_t}$)

South Africa (0.53311 + 0.401 x $\frac{i_k}{i_t}$)

ANNEX 3
WATER ALLOCATIONS AND WATER DATA FOR APPORTIONMENT
OF CAPITAL COST (Article 12 refers)

A. WATER ALLOCATIONS

A.1 HIGH ASSURANCE

The total allocations of water (in cubic hectometres per year - hm3/a) at High Assurance stated in Article 12(2) have been derived as follows:

| | EXISTING (1981) | PROVISION FOR FUTURE | TOTAL |
|---|---|---|---|
| South Africa: | | | |
| Upstream of Vygeboom Dam | 134.5[1] | 0.0 | 134.5 |
| Other | 5.5[2] | 17.8 | 23.3 |
| Sub-total South Africa | 140.0 | 17.8 | 157.8 |
| Swaziland: | 10.9[67] | 4.2 | 15.1 |
| Total | 150.9 | 22.0 | 172.9 |

A.2 LOW ASSURANCE

The total allocations of water (in cubic hectometres per year) at Low Assurance stated in Article 12(2) have been derived as follows:

| | EXISTING (1981) | PROVISION FOR FUTURE | TOTAL |
|---|---|---|---|
| South Africa: | | | |
| Upstream of Vygeboom Dam | 23.8[3] | 0.0 | 23.8 |
| Other | 260.2[4] | 97.0 | 357.2 |
| Sub-total South Africa | 284.0 | 97.0 | 381.0 |
| Swaziland: | 177.2 | 83.0 | 260.2 |
| Total | 461.2 | 180.0 | 641.2 |

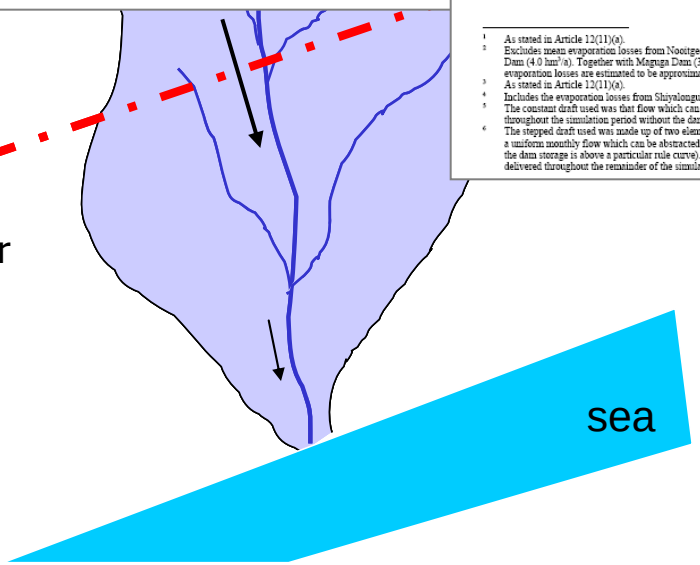
A.3 CONVERSION FACTOR

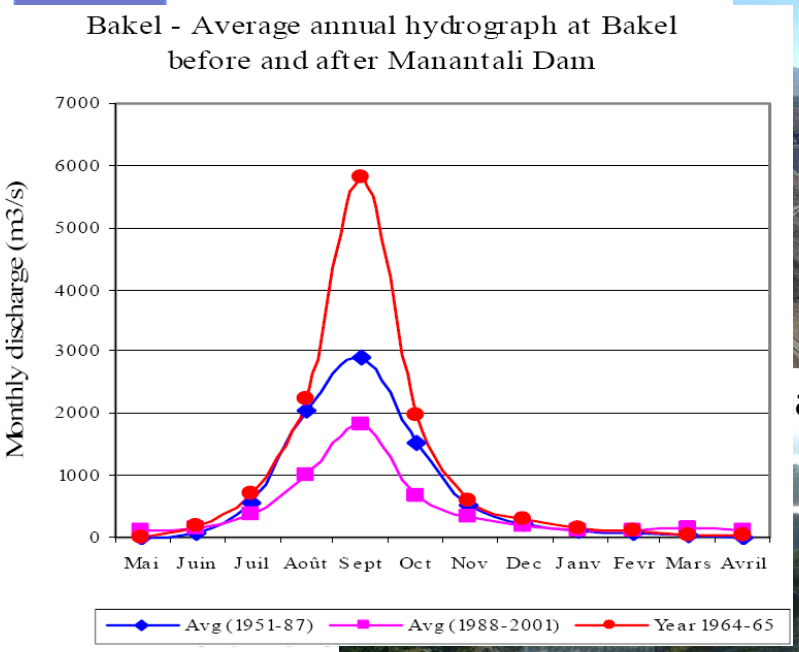
The multiplication factor for converting water at Low Assurance to water at High Assurance stated in Article 12(4) has been calculated as the ratio of the sum of the constant drafts[5] from Driekoppies and Maguga Dams to the sum of the stepped drafts[6] from Driekoppies and Maguga Dams operated independently of each other.

The multiplication factor of 0.794 stated in Article 12(4) is based on the assumption that the gross storage capacities, constant and stepped drafts are as follows:

| | DRIEKOPPIES | MAGUGA | TOTAL |
|---|---|---|---|
| Gross storage capacity ($hm^3$) | 130 | 295 | |
| Constant draft ($hm^3/a$) | 154 | 282 | 436 |
| Stepped draft ($hm^3/a$) | 183 | 366 | 549 |

1 As stated in Article 12(11)(a).
2 Excludes mean evaporation losses from Nooitgedacht and Vygeboom Dams (7.5 $hm^3/a$) and Sand River Dam (4.0 $hm^3/a$). Together with Maguga Dam (3.8 $hm^3/a$) and Driekoppies Dam (7.4 $hm^3/a$), total evaporation losses are estimated to be approximately ...(text unreadable).
3 As stated in Article 12(11)(a).
4 Includes the evaporation losses from Shiyalongubo Dam, Which have not been qualified separately.
5 The constant draft used was that flow which can be abstracted from a dam at a uniform monthly rate throughout the simulation period without the dam failing in any one month.
6 The stepped draft used was made up of two elements, the upper draft and the lower draft. The upper draft is a uniform monthly flow which can be abstracted from a dam at least 80% of the time on average (whenever the dam storage is above a particular rule curve). The lower draft is a uniform monthly flow which can be delivered throughout the remainder of the simulation period without the dam failing in any one month.



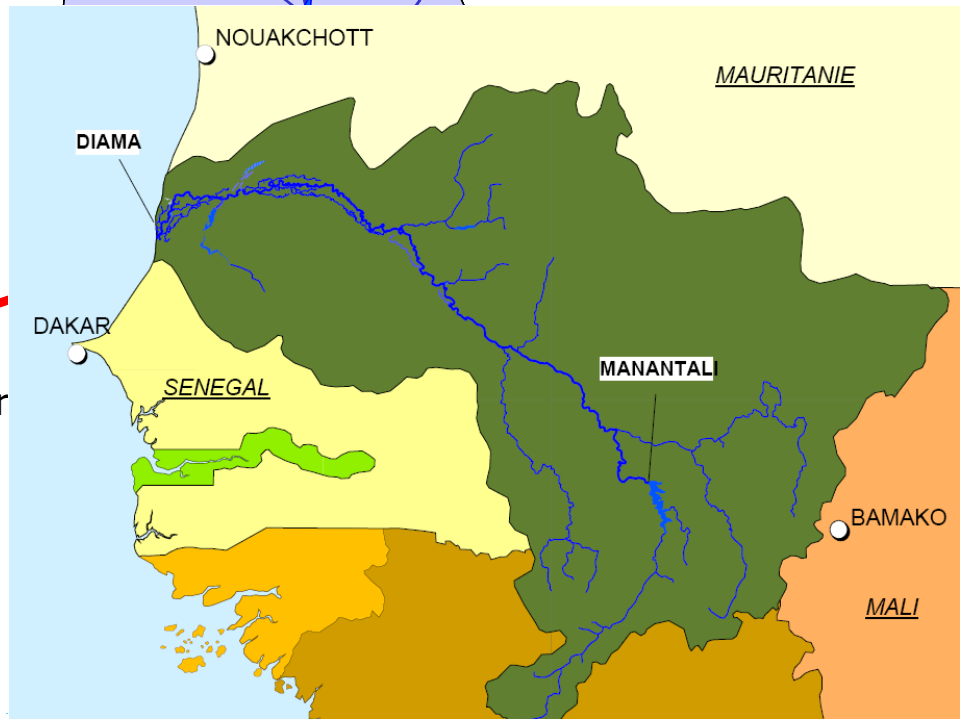



atse dam - Orange river

Kariba dam - Zambezi river

Maguga dam - Incomati river

Manantali dam - Senegal river



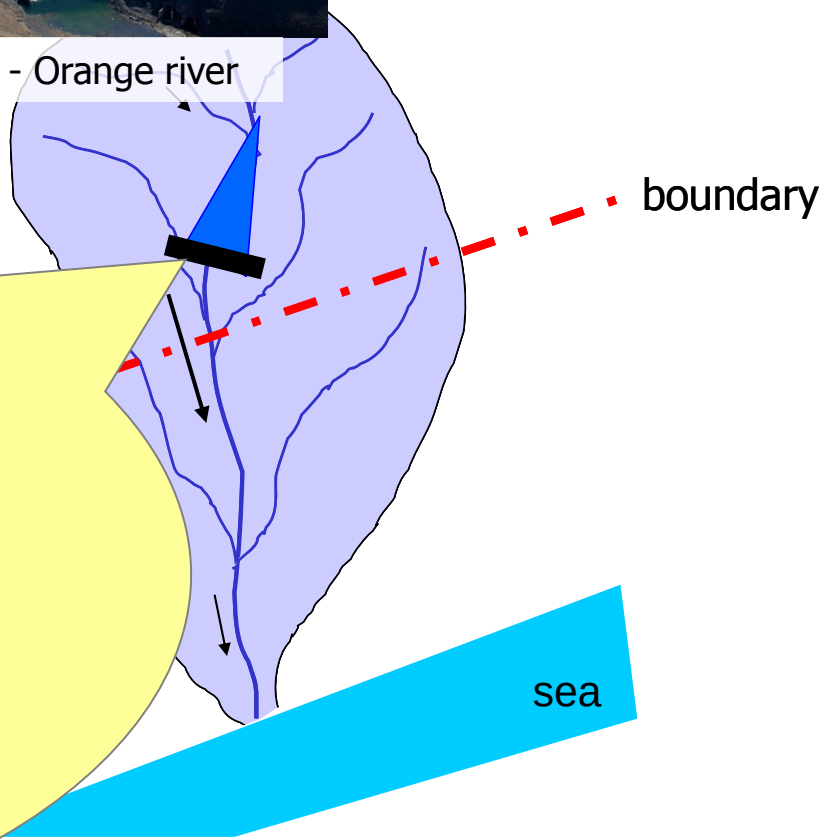
# Benefit sharing

Joint infrastructure development!

Khatse dam - Orange river

Kariba dam - Zambezi river

1. Technically ***complex*** and data intensive
2. Pre-supposes a consensus over basic water ***entitlements***
3. Should encompass ***all*** **costs** and ***all*** **benefits** across the ***entire*** basin
4. Requires effective **institutions** to re-distribute the benefits fairly



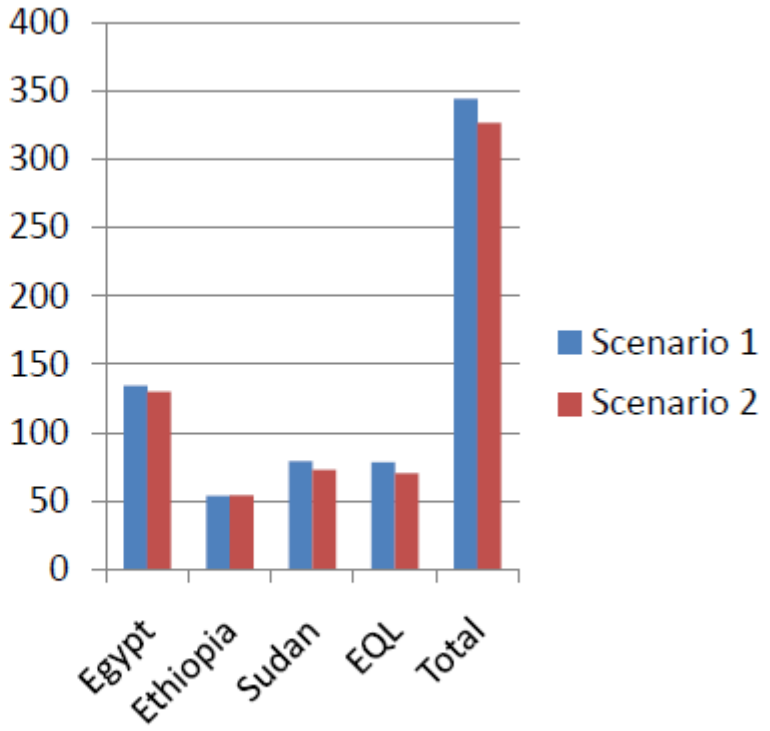
# Benefit sharing

## Blue Nile basin

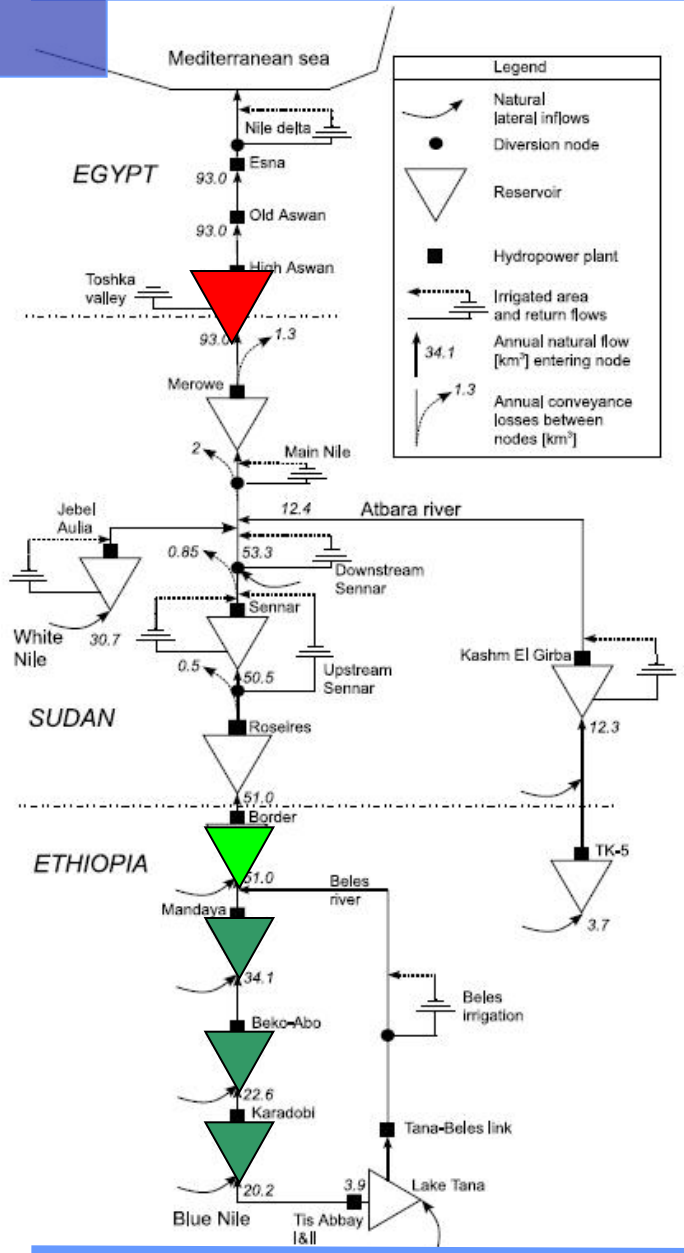

# Trade liberalization on the Eastern Nile

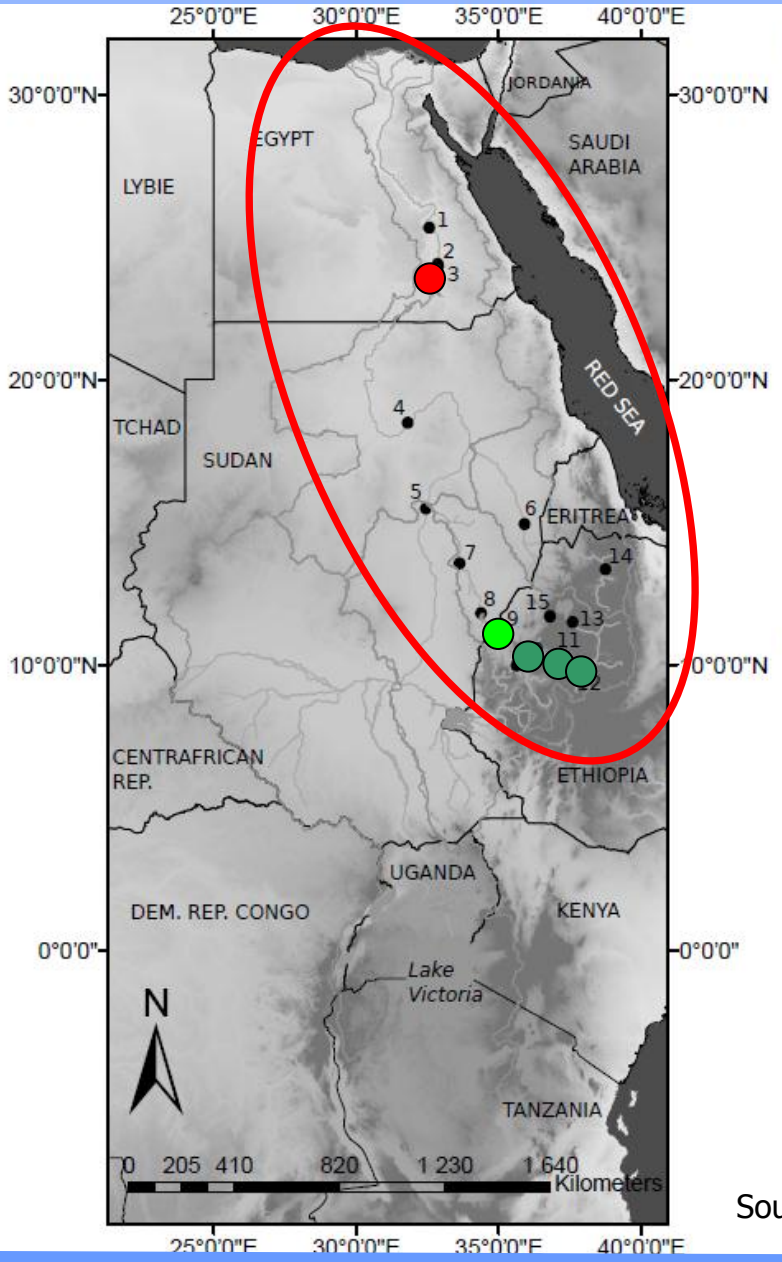
**Welfare gains**

- The welfare gains from trade liberalization are measured by Equivalent variation (EV) and real consumption expenditure
- EV measures the amount of income that would have to be given or taken away from an economy before trade policy change so as to leave the economy as well off as it would be after the policy has been changed




Source: Tewodros Kahsay, IVM-VU/UNESCO-IHE




**Legend**

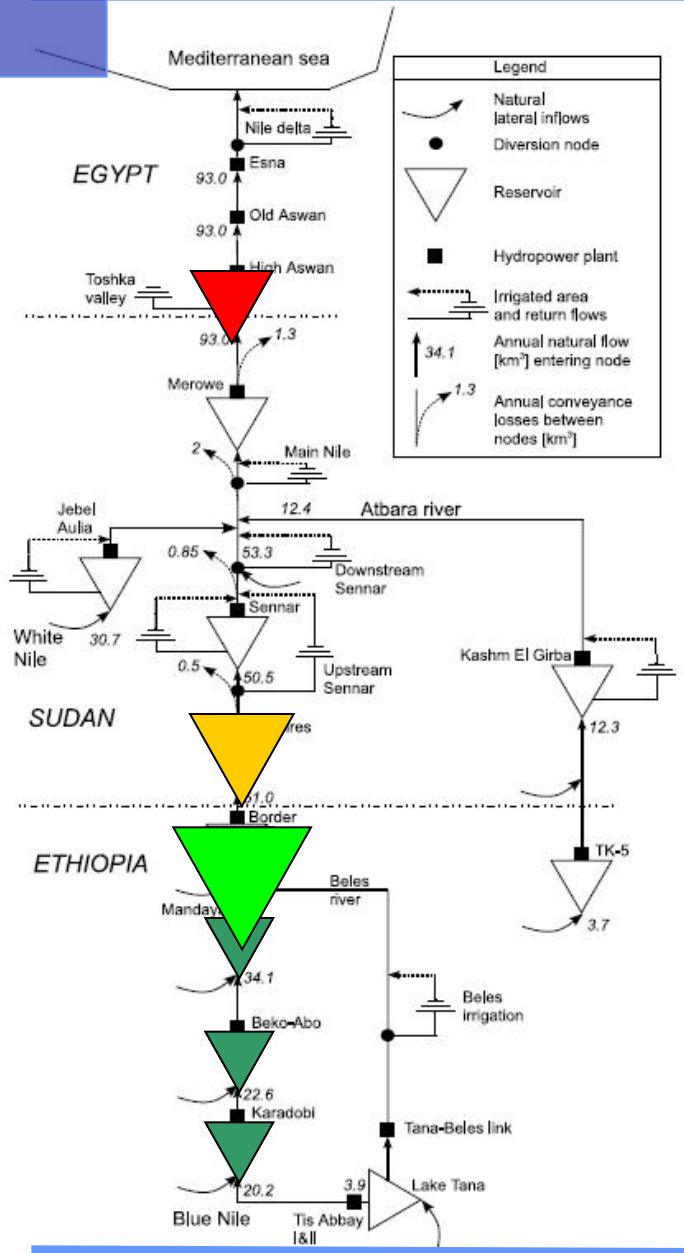
- Sub-basins
- River
- Countries Boundar
- Infrastructures
  1. Esna
  2. Old Aswan
  3. High Aswan
  4. Merowe
  5. Jebel Aulia
  6. Kashm El Girba
  7. Sennar
  8. Roseires
  9. Border
  10. Mandaya
  11. Beko-Abo
  12. Karadobi
  13. Tis Abay I&II
  14. TK-5
  15. Tana-Beles link

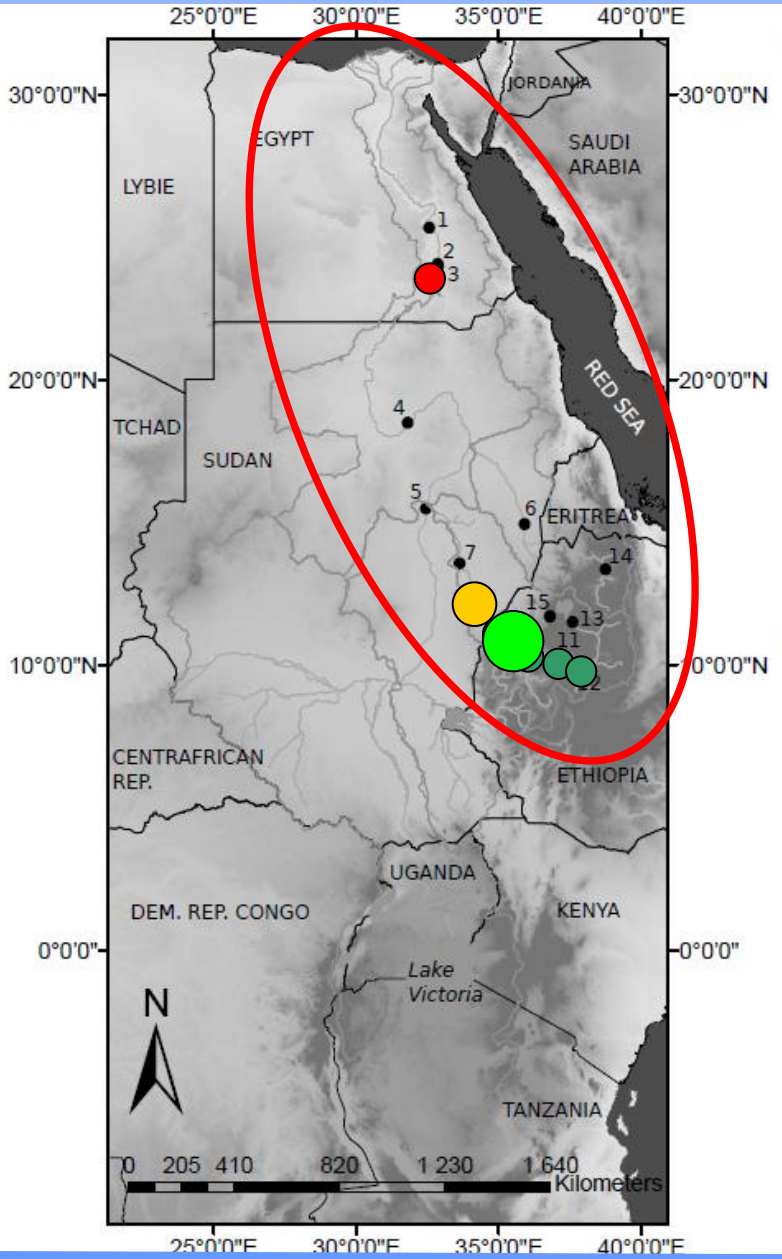
Elevation (m)

High : 5862

Low : -370

Source: Goor et al., 2010

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Elevation (m)

High : 5862

Low : -370

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Institute for Water Education

# Benefit sharing

Blue Nile basin

- More water for Egypt through reduced evaporation losses (+1.5 x $10^9$ $m^3$/a)
- Increased hydropower in Ethiopia (+1650 %)
- Increased irrigation in Sudan (+5.5 %)
- Less hydropower from Aswan for Egypt (-9%)

- Total basin-wide benefits: ~ 2 x $10^9$ US$/a

Source: Goor et al., 2010

- Excludes the sediment dimension

# Benefit sharing

## Blue Nile basin

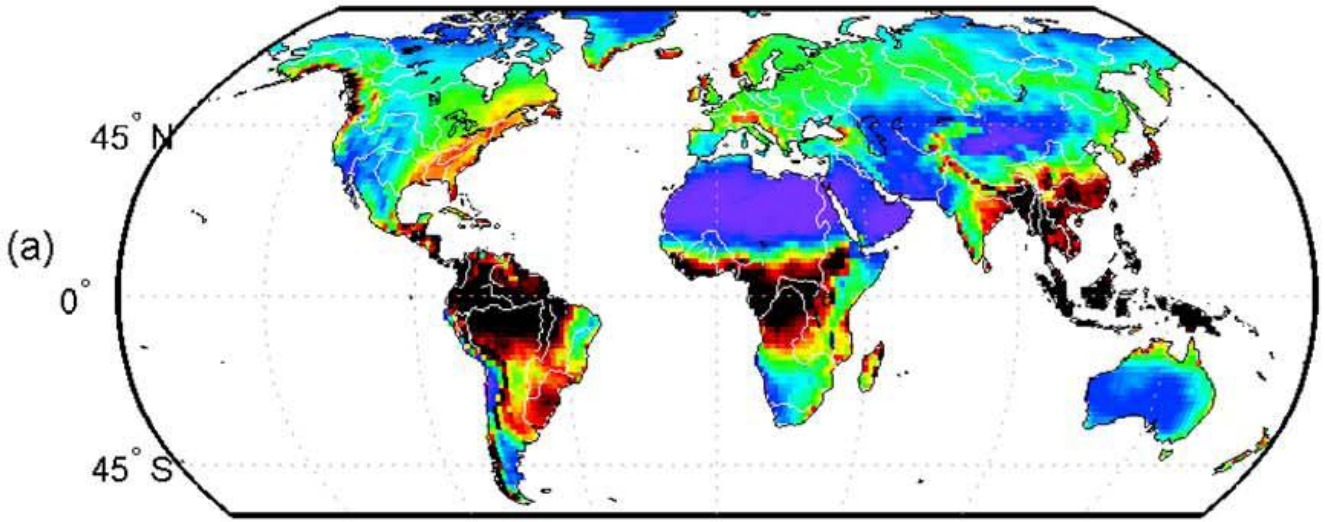

Photo: Hermen Smit

# Define system boundaries

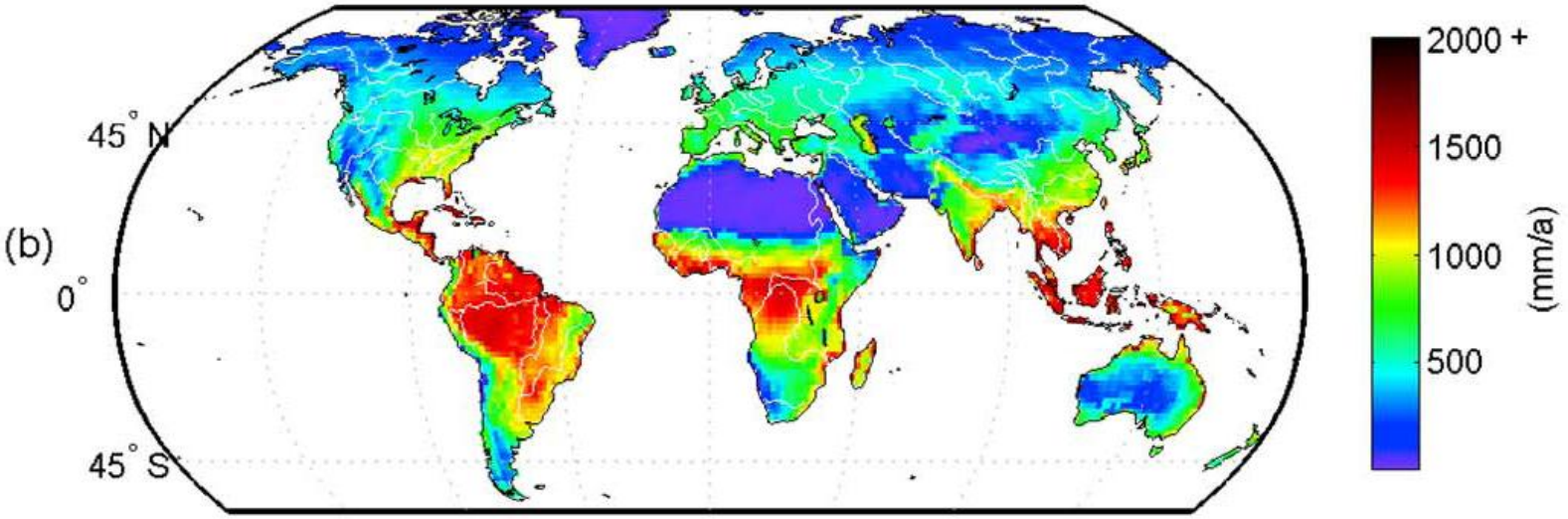
After watershed, problemshed,

Now precipitationshed, benefitshed

## Precipitation on land

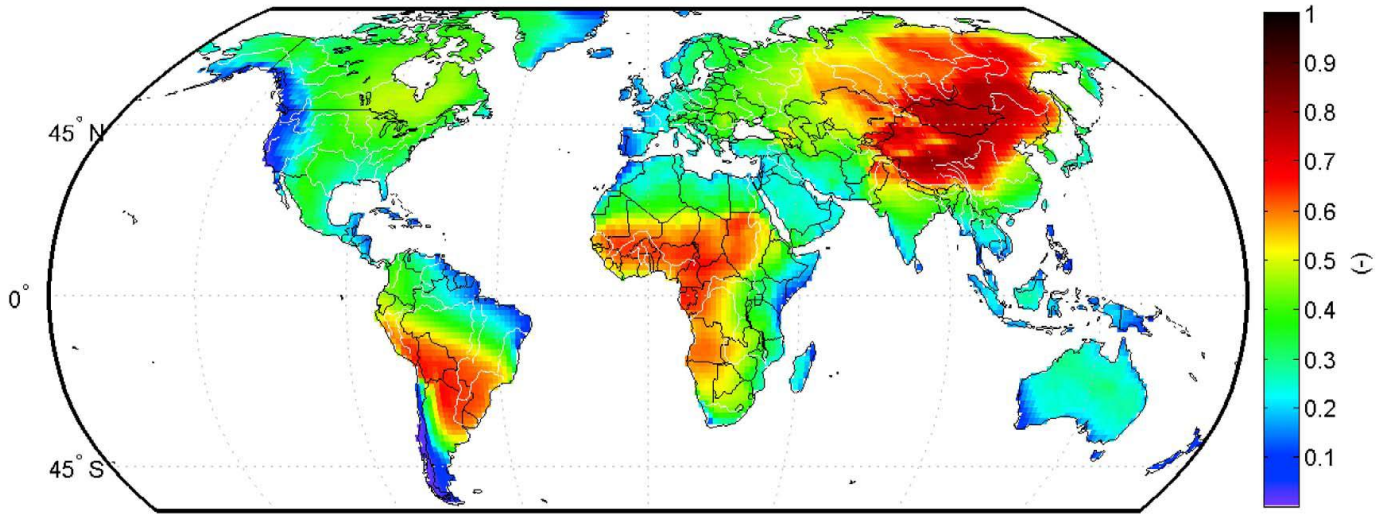



## Evaporation on land



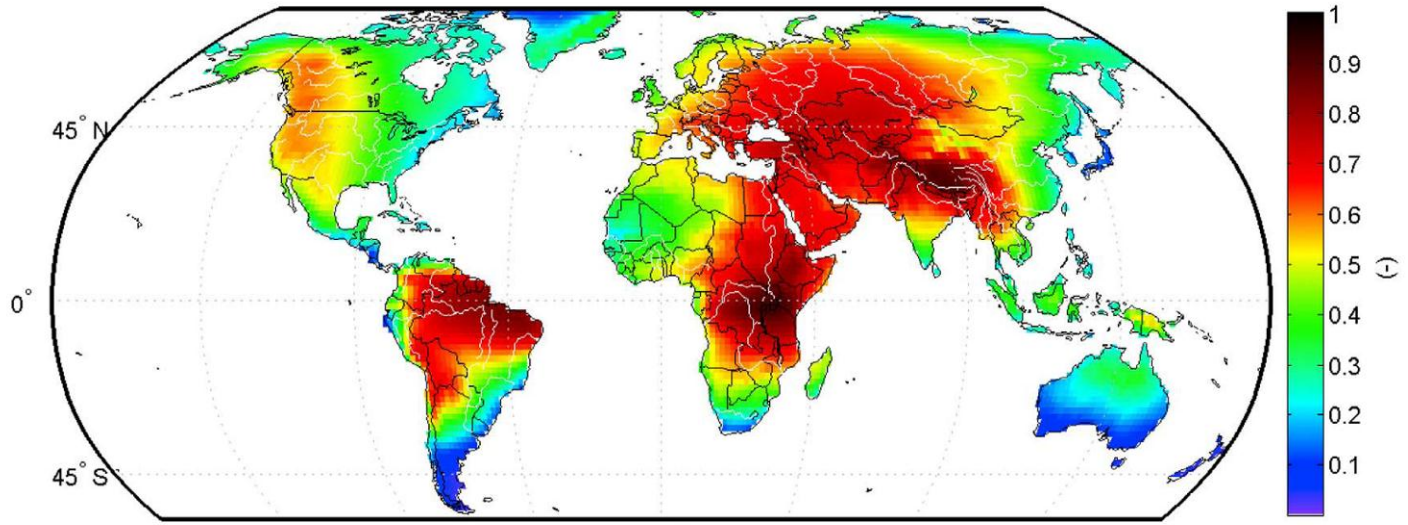

Source: Van der Ent, Savenije, Schaefli and Steel-Dunne, 2010

Continental precipitation recycling ratio $\rho_c$




part of rainfall that stems from terrestrial evaporation

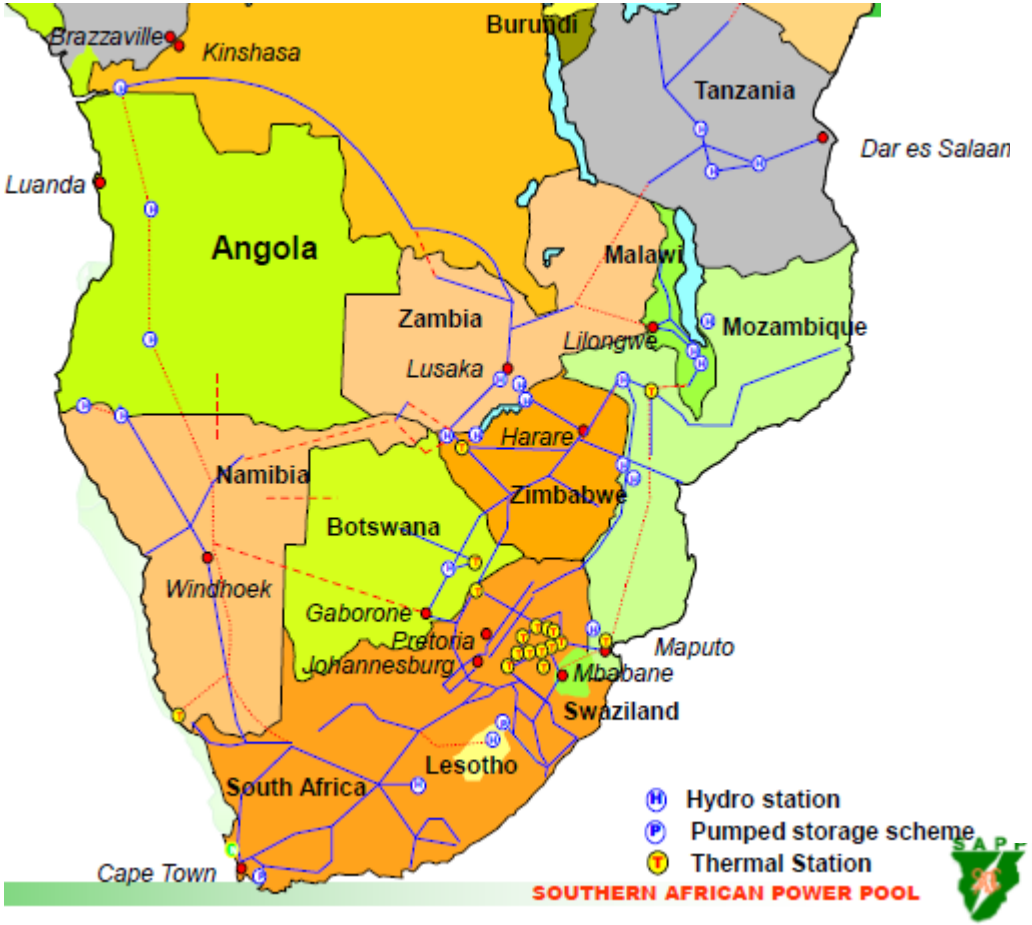
Continental evaporation recycling ratio $\varepsilon_c$




part of evaporation that returns as rainfall on land

Source: Van der Ent, Savenije, Schaefli and Steel-Dunne, 2010

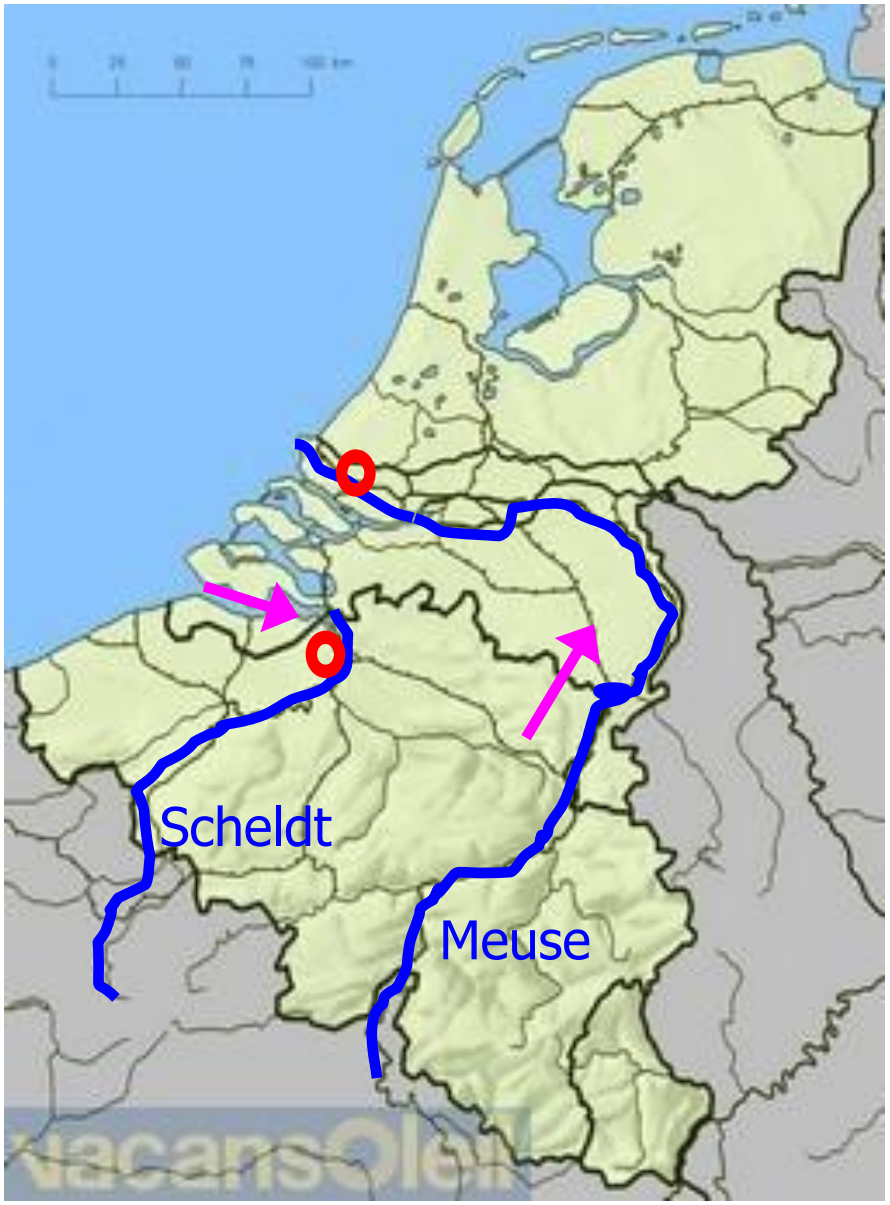
# Southern African Power Pool (SAPP)




Source: www.sapp.co.zw

# Issue linking

"benefitshed"



# Information and benefits

1. Precise and quantifiable information is generally undervalued and thus unavailable
2. Benefits of cooperation apparently compares with a baseline/default/BAU scenario – but do we have precise data on the baseline?
3. How to include all benefits and all costs across the entire (biophysical and social) system
4. How to value intangibles such as trust, sovereignty, political gain, social welfare, poverty alleviation, equality?
5. The special role of cooperation between neighbouring states/provinces – where opting out is *not* an option
6. May we simply add up the benefits and costs?

Thank you


WATERnet
UNESCO
From Potential Conflict to Cooperation Potential: Water for Peace
Conflict Prevention and Cooperation
in International Water Resources
CATALIC
IHE